Homework 3 - Left as an Exercise to the Reader

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1. Create a logical matrix that the odd entries of a Pascal triangle of order 32, and use imshow() to display the matrix. Use the function pascal(n) to generate a pascal triangle of the desired order.

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2. Calculate the theoretical probability that the sum of three rolled 20-sided dice will be greater than or equal to 50.

Hint: Generate 3 vectors representing the possible dice rolls with each spanning in different dimensions. (You can use reshape() to reshape into higher dimensions). Then, you can use broadcasting to make a 3D matrix that contains all possible sums with 3 rolls.

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3. You (probably) learned that the root mean square (RMS) value of a sine wave is $\frac{A}{\sqrt{2}}$ where A is the amplitude of the sine wave. But sometimes a sine wave might get clipped when put through an amplifier.

Create a vector that samples from the sine wave $20\sin(\pi x)$ at 2000 points starting at 0 with step size 0.001. Use logical indexing to set all entries above 12 to 12 and all entries below -12 to -12 for the sine vector (fyi there is also a way to do this with max() and min()).

With this clipped sine vector as the function, approximate the new RMS value using a left Riemann sum for estimating the integral under the square root (with a = 0, b = 2, n = 2000).

As a reminder, the left Riemann sum of f from a to b with n steps is

$$\sum_{i=0}^{n-1} f(a+i\Delta x)\Delta x,\ \Delta x = \frac{b-a}{n}$$

and the RMS value formula is

$$\text{RMS of f} = \sqrt{\frac{1}{b-a}\int_a^b (f(t))^2 \mathrm{d}t}$$